

Application No.: 10/667,522

AMENDMENTS TO THE CLAIMS:

1. (Currently Amended) A three-dimensional camera based position determination system, comprising:

an optically scannable target device fixedly attached to a target object;

at least one camera and light subsystem, each subsystem having:

an image sensing device configured to view the optically scannable target device and to generate image information indicative of geometric characteristics of the target device; and

at least one invisible light emitting diode operatively coupled to a strobe circuit, the at least one diode and circuit being configured to emit strobed invisible light thereby illuminating the optically scannable target such that the light is retro-reflected to the image sensing device and the image sensing device detects and forms an image of the target;

and

a data processing device operatively coupled to the image sensing device, the data processing device being configured to determine the orientation of the target object based on the generated target image image; and

~~a visible indicator that conclusively indicates whether the at least one invisible light emitting diode is operative.~~

2. (Original) The position determination system as recited in Claim 1, wherein the invisible light is infrared light.

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3. (Previously presented) The position determination system as recited in Claim 2, wherein the visible indicator emits light within the visible spectrum, and thereby indicates that the at least one invisible light emitting diode is operative.

4. (Original) The position determination system as recited in Claim 1, wherein the at least one invisible light emitting diode is an array of light emitting diodes.

5. (Original) The position determination system as recited in Claim 4, wherein the number of invisible light emitting diodes in the array is sixty-four.

6. (Original) The position determination system as recited in Claim 4, wherein the number of invisible light emitting diodes in the array is eighty.

7. (Original) The position determination system as recited in Claim 1 wherein the target object is a vehicle wheel, and the data processing device is further configured to determine proper wheel alignment based on orientation of the vehicle wheel.

8. (Original) The position determination system as recited in Claim 3, wherein the image sensing device includes an electronic shutter that is synchronized with the at least one strobed light emitting diode such that an image is captured only when a target is illuminated.

9. (Original) The position determination system as recited in Claim 8, wherein the image sensing device is a charge-coupled device video camera.

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10. (Original) The position determination system as recited in Claim 8, wherein the image sensing device is a complimentary metal oxide semiconductor camera.

11. (Cancelled)

12. (Original) The position determination system as recited in Claim 1, further comprising:

a current source configured to supply a current to the at least one invisible light emitting diode.

13. (Currently Amended) A three-dimensional camera based position determination system, comprising:

an optically scannable target device fixedly attached to a target object;

at least one camera and light subsystem, each subsystem having:

an image sensing device configured to view the optically scannable target device and to generate image information indicative of geometric characteristics of the target device; and

at least one invisible light emitting diode operatively coupled to a strobe circuit, the at least one diode and circuit being configured to emit strobed invisible light thereby illuminating the optically scannable target such that the invisible light is retro-reflected to the image sensing device and the image sensing device detects and forms an image of the target;

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a data processing device operatively coupled to the image sensing device, the data processing device being configured to determine the orientation of the target object based on the generated target image; and

a target object indicator, disposed on the camera and light subsystem, configured to display the status of target acquisition by the data processing device, wherein the status of target acquisition indicates whether an obtained image of the scannable target device is acceptable.

14. (Cancelled)

15. (Previously presented) The position determination system as recited in Claim 13, further comprising:

a directional indicator for indicating a manner by which the target object should be manipulated .

16. (Previously presented) The position determination system as recited in Claim 15, wherein:

the target object is a vehicle; and

the directional indicator indicates whether the vehicle should be moved forward or backward, or whether a wheel of the vehicle should be steered right or left.

17. (Currently Amended) A three-dimensional camera based position determination system, comprising:

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sensing means for sensing an image of a target device, and generating image information indicative of geometric characteristics of the target device; and

emission means for emitting strobed invisible light that illuminates the optically scannable target such that the light is retro-reflected to the image sensing device and the image sensing device detects and forms an image of the target; and

data processing means for determining the orientation of the target object based on the generated target image; and

~~visible indicator means for conclusively indicating whether the emission means is~~
operative.

18. (Original) The position determination system as recited in Claim 17, wherein the invisible light is infrared light.

19. (Currently Amended) The position determination system as recited in Claim ~~[[18,]]~~ 31, wherein the visible indicator means emits light within the visible spectrum, and thereby indicates that the emission means is operative.

20. (Original) The position determination system as recited in Claim 17, wherein the target object is a vehicle wheel, and the data processing means is configured to determine proper wheel alignment based on orientation of the vehicle wheel.

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21. (Original) The position determination system as recited in Claim 17, wherein the image sensing means includes an electronic shutter that is synchronized with the emission means such that an image is captured only when a target is illuminated.

22. (Original) The position determination system as recited in Claim 17, further comprising:

attachment means for fixedly attaching an optically scannable target device to a target object.

23. (Original) The position determination system as recited in Claim 17, further comprising:

directional means for indicating the direction in which a target object should be repositioned, and for indicating that a target object has been properly positioned.

24. (Original) The position determination system as recited in Claim 17, further comprising:

target object indicator means for indicating that the sensing means is sensing the target object.

25. (Original) The position determination system as recited in Claim 17, further comprising:

target object indicator means for indicating the state of target acquisition by the data processing device.

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26. (Previously presented) An image-based position determination system for optically scanning a target device related to an object, the system comprising:

- at least one camera and light subsystem, each subsystem having:
 - an image sensing device configured to view the target device and to generate image information indicative of geometric characteristics of the target device;
 - at least one light emitting diode operatively coupled to a strobe circuit, the at least one diode and circuit being configured to emit strobed light thereby illuminating the target device such that the light is retro-reflected to the image sensing device and the image sensing device detects and forms an image of the target; and
 - a visual indicator for indicating a manner by which the object should be manipulated such that the image sensing device obtains an image of the target device in a different position;
- and
- a data processing device configured to couple to the visual indicator and the image sensing device to determine the orientation of the object based on the generated target image.

27. (Previously presented) An image-based position determination system for optically scanning a target device related to an object, the system comprising:

- at least one image sensing and light subsystem, each subsystem having:
 - image sensing means for viewing the target device and for generating image information indicative of geometric characteristics of the target device;

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light emitting means for emitting strobed light thereby illuminating the target device such that the light is retro-reflected to the image sensing means and the image sensing means detects and forms an image of the target; and

visual indicator means for indicating a manner by which the object should be manipulated such that the image sensing means obtains an image of the target device in a different position;

and

a data processing device configured to couple to the visual indicator means and the image sensing means to determine the orientation of the object based on the generated target image.

28. (Previously presented) A three-dimensional camera based position determination system, comprising:

an optically scannable target device fixedly attached to a target object;

at least one camera and light subsystem, each subsystem having:

an image sensing device configured to view the optically scannable target device and to generate image information indicative of geometric characteristics of the target device;

at least one light emitting diode operatively coupled to a strobe circuit, the at least one diode and circuit being configured to emit strobed light thereby illuminating the optically scannable target such that the light is retro-reflected to the image sensing device and the image sensing device detects and forms an image of the target; and

directional means for indicating the direction in which the target object should be repositioned, and for indicating whether the target object has been properly positioned;

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a data processing device operatively coupled to the image sensing device, the data processing device being configured to determine the orientation of the target object based on the generated target image; and

a target object indicator that displays the status of target acquisition by the data processing device, wherein the status of target acquisition indicates whether an obtained image of the scannable target device is acceptable.

29. (Currently Amended) The system of claim [[1,]] 30, wherein the visible indicator is disposed in the camera and light subsystem.

30. (New) The system of claim 1 further including a visible indicator that conclusively indicates whether the at least one invisible light emitting diode is operative.

31. (New) The system of claim 17 further including visible indicator means for conclusively indicating whether the emission means is operative.